66409-224-7

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	PATENT
	)	
Satoshi HIROSAWA *et al.*	)	GROUP: 1742
	)	
Serial No. 10/634,856	)	EXAMINER: WYSZOMIERSKI, G. P.
	)	
Filed: August 6, 2003	)	CONFIRMATION NO. 9153
	)	
MAGNETICALLY ANISOTROPIC SINTERED MAGNETS	)	CUSTOMER NO. 25269

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APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

April 12, 2006

Sir:

1. Real Party In Interest

The real party in interest to this appeal is Sumitomo Special Metals Co., Ltd. of Tokyo, Japan.

2. Related Appeals and Interferences

There are no other known appeals or interferences which would have a bearing on, or be influenced by, the present appeal.

3. Status of Claims

Claims 1-5 were presented to the examiner for consideration during the prosecution of this application. Claims 1-5 are on appeal and are reproduced in Appendix I.

4. Status of Amendments

No Amendments have been filed subsequent to the issuance of the final Office Action of July 12, 2005.

5. Summary of Claimed Subject Matter

The present invention relates to Fe-B-R-based magnetically anisotropic sintered magnets for use in electric and electronic equipment which include increased amounts of boron for increased coercive force, as well as controlled small amounts of impurities to increase coercive force without reducing the minimum energy product (specification at page 3, lines 20-27). In particular, the Fe-B-R-based magnetically anisotropic magnets contain 9-18 at% boron (see examples), small amounts of Al, Si and Cu, and at least one of Cr, Mn and Ni. The magnets display a coercive force of more than 15 KO_e and a maximum energy product of more than 20 MGO_e (specification at page 3, lines 13-18).

According to a first embodiment (specification at page 4, lines 10-14), the magnet consists essentially of, by atomic percent, 14-18% R wherein R is selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu, and at least one element selected from the group consisting of Cr, Mn and Ni and wherein the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

and the balance being Fe.

In a second embodiment (specification at page 4, lines 15-22), the magnet consists essentially of, by atomic percent, 14-18% R wherein R is selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu, and at least one element selected from the group consisting of Cr, Mn and Ni and wherein the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%[1]
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

less than 2.0% of a total amount of more than zero and less than 2.0% of at least one element selected from the group consisting of V, Mo, Nb and W and more than zero and less than 1.0% of at least one element selected from the group consisting of Zn, Ti, Zr, Hf, Ta, Ge, Sn, Bi, Ca and Mg, and the balance being Fe.

In a third embodiment (specification at page 4, line 23 to page 5, line 2), the magnet consists essentially of, by atomic percent, 14-18% R wherein R wherein R is selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A, wherein A is the total of Al, Si and Cu, and at least one of the elements selected from the group consisting of Cr, Mn and Ni and provided that the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%

[1] The specification recites a range of 0.01 to 0.05% which is an obvious mistake . . . see original claim 2.

Mn	0.05-1.0%	Ni	0.02-1.0%

less than 10% Co, and the balance being Fe.

In a fourth embodiment (specification at page 5, lines 3-8), the magnet consists essentially of, by atomic percent, 14-18% R wherein R is less than 2.5% of an element selected from the group consisting of Dy and Tb as a part of R and the balance of R is Nd and/or Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu and at least one of Cr, Mn and Ni, and wherein the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

and the balance being Fe.

In a fifth embodiment (specification at page 5, lines 9-21), the magnet consists essentially of, by atomic percent, 14-18% R wherein R wherein R is less than 2.5% of an element selected from the group consisting of Dy and Tb as a part of R and the balance of R being selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu and at least one element selected from the group consisting of Cr, Mn and Ni, and wherein the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

less than 2.0% of a total amount of less than 2.0% of at least one element selected from the group consisting of V, Mo, Nb and W and less than 1.0% at least one element selected from the group consisting of Zn, Ti, Zr, Hf, Ta, Ge, Sn, Bi, Ca and Mg, less than 10% Co, and the balance being Fe.

6. Grounds of Rejection to be Reviewed

a. First rejection: whether the examiner has properly rejected claims 1, 2 and 4 under 35 U.S.C. §103(a) as being unpatentable over Fujimura et al. (U.S. Patent No. 4,773,950).

b. Second rejection: whether the examiner has properly rejected claims 3 and 5 under 35 U.S.C. §103(a) as being unpatentable over Fujimura et al. in view of Matsuura et al. (U.S. Patent No. 4,597,938) or Sagawa et al. (U.S. Patent No. 4,792,368).

c. Third rejection: whether the examiner has properly rejected claims 3 and 5 under 35 U.S.C. §103(a) as being unpatentable over Tokunaga et al. (U.S. Patent No. 5,041,172).

7. Arguments

a. The examiner's rejection of claims 1, 2, and 4 under 35 U.S.C. §103(a) as being unpatentable over Fujimura et al.

Fujimura et al. disclose a magnetically anisotropic sintered permanent magnet of the FeBR system in which R is the sum of R_1 and R_2, R_1 being Dy, Tb, Gd, Ho, Er, Tm and/or Yb, and R_2 being 80 at% or more of Nd and Pr and a balance of at least one other rare earth exclusive of

R_1. The system includes 0.05 to 5 at% R_1, 12.5 to 20 at% R, 4 to 20 at% B and a balance of Fe with impurities. Additional elements M such as Ti, Zr, Hf, Cr, Mn, Ni, Ta, Ge, Sn, Sb, Bi, Mo, Nb, Al, V and W may be present. Certain alloy examples are identified in Tables 2 and 3, a few of which include 10 at% of boron. However, Fujimura et al. do not disclose or suggest an Fe-B-R magnet which includes 9 to 18 at% boron, which includes the elements specifically recited in claims 1, 2 and 4, and which also display a coercive force of more than 15 KO_e and a maximum energy product of more than 20 MGO_e.

The examiner refers to alloy examples in Table 3 in Fujimura et al. as displaying coercive force and maximum energy product in the appellants' claimed range; however, the alloys therein do not contain boron in the range of 9-18 at% as defined in the appellants' claims.

Recognizing that Fujimura et al. do not disclose a magnet as defined in appellants' claims, the examiner asserts that it would be obvious to optimize the amounts of elements disclosed by Fujimura et al.

The appellants' vigorously dispute this conclusion. When using a high boron content (9-18 at%) in the magnet, it would not be a mere optimization to determine what added elements would result in properties of more than 15KO_e and 20 MGO_e. The inventors derived these values only through extensive investigations.

In Table II of Fujimura et al. the alloys tested all included Dy, which is not necessary to achieve the results of the present invention.

The examiner's rejection of claims 1, 2 and 4 based on Fujimura et al. should be reversed.

b. The examiner's rejection of claims 3 and 5 under 35 U.S.C. §103(a) as being unpatentable over Fujimura et al. in view of Matsuura et al. or Sagawa et al.

Fujimura et al. is summarized above.

Matsuura et al. disclose a process for producing permanent anisotropic or isotropic magnet materials of the Fe-B-R type wherein A metallic powder having a mean particle size of 0.3 to 8 microns is compacted and sintered at a temperature of 900 to 1200°C, the powder having a composition of 8 to 30 at% R 2 to 28 at% B, Fe, with up to 50 at % Co, and optionally Ti, Ni, Bi, V, Nb, Ta, Cr, Mo, W, Mn, Al, Sb, Ge, Sn, Zr and Hf. According to col. 2, lines 36-54, the disclosed magnet materials do not need to contain cobalt, but when included to 50 at % or less, the Curie points can be increased.

Sagawa et al. disclose magnetic materials and sintered anisotropic permanent magnets made therefrom which comprise Fe, B, R and Co in amounts of 8-30 at % R, 2-28 at % B, at least 50 at % Co, and a balance of Fe with impurities. The magnetic material has an intrinsic coercivity of at least $1KO_e$ and a maximum energy product of at least $10MGO_e$ upon sintering. According to col. 8, lines 31 et seq. the inclusion of cobalt in the Fe-B-R magnets increases resistance to temperature dependency and to corrosion.

The examiner asserts that, based on either Matsuura et al. or Sagawa et al., it would be obvious to include cobalt in the magnets of Fujimura et al.

This assertion is incorrect insofar as Fujimura et al. specifically state that they avoid use of cobalt (col. 1, first paragraph).

And in any event, nothing in Matsuura et al. or Sagawa et al. would overcome the deficiencies in Fujimura et al., which deficiencies as noted above apply to claims 3 and 5 as well as claims 1, 2 and 4.

The examiner's rejection of claims 3 and 5 based on Fujimura et al., Matsuura et al. and Sagawa et al. should be withdrawn.

c. The examiner's rejection of claims 3 and 5 under 35 U.S.C. §103(a) as being unpatentable over Tokunaga et al.

Tokunaga et al. disclose an Nd-Fe-B permanent magnet having intrinsic coercivity of 15 KO_e or more and a composition

$(Nd_{1-a}\ Dy_a)\ Fe_{1-x-y-z}\ Co_x\ B_y\ M_z)\alpha$

wherein M is selected from Nb, Mo, Al, Si, P, Zr, Cu, V, W, Ti, Ni, Cr, Hf, Mn, Bi, Sn, Sb, and Ge, $0.01 \leq x \leq 0.04$, $0.04 \leq y \leq 0.20$, $0 \leq z \leq 0.03$, $4 \leq a \leq 7.5$, and $0.03 \leq \alpha \leq 0.40$.

In Tables 2 and 3 certain alloys are disclosed. However, none with high boron contents and element inclusions as defined in appellants' claims 3 and 5.

The examiner admits that "no specific example of the prior art (Tokunaga et al.) contains all of the elements as presently recited"; however, he refers to overlap and asserts that "(o)"ne of ordinary skill in

the art would have arrived at the contents of the presently claimed magnets by optimizing the amounts of elements as disclosed by Tokunaga et al. ...."

The appellants reply that the examiner is incorrect. The specific ranges defined in claims 3 and 5 are not obtainable by optimizations and are not at all suggested by Tokunaga et al. The examiner has failed to set forth a proper *prima facie* rejection.

8. Conclusions

It is asserted that the examiner's rejections should be reversed and claims 1-5 allowed.

The government filing fee should be charged to Deposit Account No. 04-2223.

Respectfully submitted,

DYKEMA GOSSETT PLLC

By: _____

Richard H. Tushin
Registration No. 27,297
DYKEMA GOSSETT PLLC
Franklin Square, Third Floor West
1300 I Street N.W.
Washington, DC 20005-3353
(202) 906-8600

APPENDIX I

1. A magnetically anisotropic sintered magnet having a coercive force of more than $15KO_e$ and a maximum energy product of more than 20 MGO_e and consisting essentially of, by atomic percent, 14-18% R wherein R is selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu, and at least one element selected from the group consisting of Cr, Mn and Ni and provided that the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

and the balance being Fe.

2. A magnetically anisotropic sintered magnet having a coercive force of more than $15KO_e$ and a maximum energy product of more than 20 MGO_e and consisting essentially of, by atomic percent, 14-18% R wherein R is selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu, and at least one element selected from the group consisting of Cr, Mn and Ni and provided that the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

less than 2.0% of a total amount of more than zero and less than 2.0% of at least one element selected from the group consisting of V, Mo, Nb and W and more than zero and less than 1.0% of at least one element selected from the group consisting of Zn, Ti, Zr, Hf, Ta, Ge, Sn, Bi, Ca and Mg, and the balance being Fe.

3. A magnetically anisotropic sintered magnet having a coercive force of more than $15KO_e$ and a maximum energy product of more than 20 MGO_e and consisting essentially of, by atomic percent, 14-18% R wherein R is selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A, wherein A is the total of Al, Si and Cu, and at least one of the elements selected from the group consisting of Cr, Mn and Ni and provided that the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

less than 10% Co, and the balance being Fe.

4. A magnetically anisotropic sintered magnet having a coercive force of more than $15KO_e$ and a maximum energy product of more than 20 MGO_e and consisting essentially of, by atomic percent, 14-18% R wherein R is less than 2.5% of an element selected from the group consisting of Dy and Tb as a part of R and the balance of R being selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu and at least one of element selected from the group

consisting of Cr, Mn and Ni, and provided that the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

and the balance being Fe.

5. A magnetically anisotropic sintered magnet having a coercive force of more than $15KO_e$ and a maximum energy product of more than 20 MGO_e and consisting essentially of, by atomic percent, 14-18% R wherein R is less than 2.5% of an element selected from the group consisting of Dy and Tb as a part of R and the balance of R being selected from the group consisting of Nd and Pr, 9-18% B, 0.5-5% A wherein A is the total of Al, Si and Cu and at least one element selected from the group consisting of Cr, Mn and Ni, and provided that the range of each element is

Al	0.2-2.0%,	Si	0.01-0.5%
Cu	0.03-0.6%	Cr	0.02-3.0%
Mn	0.05-1.0%	Ni	0.02-1.0%

less than 2.0% of a total amount of less than 2.0% of at least one element selected from the group consisting of V, Mo, Nb and W and less than 1.0% at least one element selected from the group consisting of Zn, Ti, Zr, Hf, Ta, Ge, Sn, Bi, Ca and Mg, less than 10% Co, and the balance being Fe.